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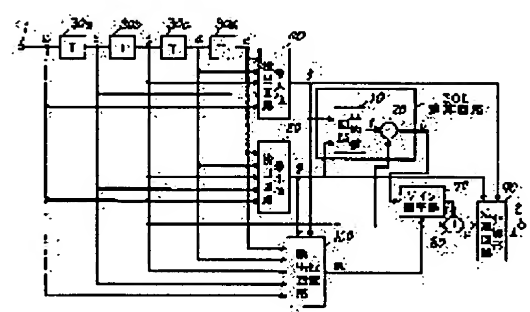
(54) CONTOUR CORRECTION DEVICE

(57)Abstract:
PURPOSE: To provide a contour correction device implementing contour correction without addition of undershoot and overshoot concerning the contour correction device to correct a contour of a picture thereby improving sharpness.
CONSTITUTION: A contour correction component is obtained as an output signal of an arithmetic operation circuit 300. A position detection circuit 100 detects the occurred position of a maximum value and a minimum value. The position detection circuit 100 makes a gain of a gain adjustment device 70 zero when a maximum value and a minimum value take place in the same direction for a noted point in a contour of a specific structure. The circuit 100 sets the gain to a significant value in the case of another type of contour. Through the above- mentioned operation, the contour is corrected without losing a proper geometrical structure of an original picture.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention rectifies the profile of a picture image and relates to the profile compensator for raising sharpness.
[0002]
[Description of the Prior Art] There is a profile compensator of the Japanese Patent Application No. [42557 / four to] publication as a means which improves sharpness, without adding a pli chute and an over shoot to the profile fraction of a picture image.
[0003] An example of the conventional profile compensator is shown in drawing 13 . drawing 13 -- setting -- 1 -- the input terminal of a video signal, and 2 -- an output terminal and 10 -- an average circuit and 20 -- a subtractor and 30a, 30b, 30c, and 30d -- for a minimum value detector and 70, as for an adder and 90, a gain-adjustment machine and 80 are [a 1 pixel retardation machine and 40 / a maximum detector and 50 / a nonlinear-processing circuit and 300] arithmetic circuits
[0004] An input video signal is delayed with the 1 pixel retardation vessels 30a, 30b, 30c, and 30d. An input video signal and a 1 pixel delay circuits [30a, 30b, 30c, and 30d] output signal are supplied to the maximum detector 40 and the minimum value detector 50, respectively. The output signal of 1 pixel retardation machine 30b is supplied to one input terminal of a subtractor 20, and one input terminal of an adder 80, respectively. The output signal of the maximum detector 40 is supplied to the average circuit 10 and the nonlinear-processing circuit 90, respectively.
[0005] The output signal of the minimum value detector 50 is supplied to the average circuit 10 and the nonlinear-processing circuit 90, respectively. While will accept the output signal of the average circuit 10 subtractor 20, and it is supplied to an input terminal. The subtraction result of a subtractor 20 is supplied to the gain-adjustment machine 70, while will accept the output signal of the gain-adjustment machine 70 adder 80, and it is supplied to an input terminal. In the nonlinear-processing circuit 90, according to the output signal from the maximum detector 40, and the output signal from the minimum value detector 50, the nonlinear processing of the addition result of an adder 80 is carried out, and it is outputted from an output terminal 2.
[0006] It explains, making reference the wave form chart showing in drawing 14 about an operation of the conventional profile compensator constituted as mentioned above. The signal wave form shown in (a) - (l) in drawing 14 is equivalent to the signal wave form obtained on each point a-l in drawing 13 .
[0007] First, suppose that the video signal with a profile which is shown in drawing 14 (a) from an input terminal 1 in drawing 13 is inputted. This video signal obtains the signal wave form which is delayed with the 1 pixel retardation vessels 30a, 30b, 30c, and 30d, and is shown in drawing 14 (b) - (e) in b, c, d, and e each point. The maximum detector 40 compares the size of input signals a-e, and outputs the greatest value. Therefore, the signal wave form shown in drawing 14 (f) in f points is obtained.
[0008] The minimum value detector 50 compares the size of the inputted input signals a-e, and outputs the minimum value. Therefore, the signal wave form shown in drawing 14 (g) in g points is obtained. The signal indicated to be drawing 14 (f) to (g) obtains the signal wave form which the average is taken in the average circuit 10 and shown in drawing 14 (h).
[0009] In a subtractor 20, the signal in h points is subtracted from output signal c of 1 pixel retardation machine 30b, and the signal wave form of drawing 14 (i) is obtained. If the gain of the gain-adjustment machine 70 is set as 1, the output signal serves as the signal wave form shown in drawing 14 (j), and if it adds with the output signal from 1 pixel retardation machine 30b shown in drawing 14 (c), in an adder 80, the signal wave form shown in drawing 14 (k) as an addition result of an adder 80 will be obtained. In the nonlinear-processing circuit 90, the nonlinear

processing of this signal is carried out according to the output signal of the maximum detector 40 and the minimum value detector 50.
[0010] For example, the size of a signal wave form (f), (k), and (l) is compared, and a signal (k) outputs a signal (f), when larger than a signal (f). Moreover, as for the parvus case, a signal (k) outputs a signal (g) from a signal (g). A signal (k) is outputted when other. That is, an amplitude is restricted using the detected maximum or the minimum value. If this is followed, the video signal with which the inclination of a profile which is shown in drawing 14 (l) became steep as an output signal of the nonlinear-processing circuit 90 will be obtained.
[0011] Thus, according to the conventional profile compensator, sharpness can be improved, without adding undershooting and an over shoot (the profile correction technique which was mentioned above is described to be a profile inclination correction type for the sake of the convenience of the following explanations.).
[0012]
[Problem(s) to be Solved by the Invention] However, with a configuration which was mentioned above, it had the fault of losing the geometric structure of a subject-copy image to a certain specific profile picture image.
[0013] For example, when performing the conventional profile correction processing to the profile signal of the shape of a trapezoid which is shown in drawing 15 (b), the signal of drawing 15 (b) is acquired as a maximum detection result corresponding to the signal of drawing 15 (b). Moreover, the signal of drawing 15 (c) is acquired as a minimum value detection result. Therefore, an average signal turns into the signal of drawing 15 (d), it becomes the signal of drawing 15 (e), and the result which subtracted this average signal from HARASHIN number (b) will serve as the signal of drawing 15 (**), if this is added to HARASHIN number (b). According to a maximum detection result and a minimum value detection result, the nonlinear control of the signal of drawing 15 (**) is carried out, and it acquires the signal of drawing 15 (g) as a result. The raised bottom fraction of a trapezoid-like profile will become flat, and the geometric structure of a subject-copy image will be lost so that more clearly than this wave.
[0014] Then, this invention offers the profile compensator which can perform profile correction, without losing the geometric structure of a subject-copy image in view of the above-mentioned technical probrem.
[0015] With a configuration which was furthermore mentioned above, it had the fault that distortion arose to the profile with a large amplitude.
[0016] For example, when profile correction processing of the conventional example is carried out to the profile signal ((A), (B)) with which a profile amplitude which is shown in drawing 16 (**) is different, a profile correction picture image becomes like drawing 16 (b). Although the effect of a sharpness improvement is large since the amplitude oppressed in a nonlinear processing about the profile especially with a large amplitude is large, in connection with it, distortion also becomes large. Such a phenomenon appears notably, when the picture image which has a profile in the orientation of slant like drawing 17 (b) is rectified in the picture image displayed by raster **** like especially a television signal. The wave corresponding to each scanning line of drawing 17 (b) has become like drawing 17 (b).
[0017] If profile correction processing of the picture image of drawing 17 (b) is carried out, it will become a picture image which is shown in drawing 17 (c), and a stair-like distortion will be produced in the profile fraction of the orientation of slant. drawing -- 17 -- (c) -- each -- the scanning line -- corresponding -- a wave -- < -- A -- HREF -- = -- " -- /-- Tokujitu -- /-- tjitemdrw -- . -- ipdl -- ? -- N -- 0000 -- = -- 237 -- & -- N -- 0500 -- = -- one -- E -- _ -- N -- /--; -- ? -- : -- < - - > -- nine -- < -- six -- = -- /-- /-- /-- & -- N -- 0001 -- = -- 116 -- drawing 17(d) -- expiring -- kana -- like, the minimum amount of phase shifts for every scanning line for distortion displaying a slanting line originates in that it is a 1 pixel unit and a less than 1-pixel shift amount cannot be expressed, and it becomes so remarkable that a profile amplitude is large and the profile correction effect is large Moreover, a profile amplitude is conspicuous a parvus case and, as for distortion, contrast is seldom conspicuous for a parvus reason from the first.
[0018] Then, this invention offers the profile compensator which can perform profile correction, without producing distortion in view of the above-mentioned technical probrem, even if it is the profile of the orientation of slant.
[0019]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the profile compensator of the 1st invention (claim 1) A maximum detection means to detect maximum from two or more pixel signals near the attention pixel of an input video signal, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned

maximum detector, the above-mentioned minimum value detector, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and an addition means to add the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, The nonlinear-processing means which considers the output signal of the above-mentioned addition means as an input, two or more pixel signals near [above-mentioned] the attention pixel, the output signal from the above-mentioned maximum detection means, and the output signal from the above-mentioned minimum value detection means are considered as an input, and it has a position detection means to detect the occurrence position of maximum and the minimum value.

[0020] A maximum detection means by which the profile compensator of the 2nd invention (claim 3) detects maximum from two or more pixel signals near the attention pixel of an input video signal, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detection means, the above-mentioned minimum value detection means, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and an addition means to add the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, It has the nonlinear-processing means which considers the output signal of the above-mentioned addition means as an input, and a profile amplitude detection means to consider an output signal as an input from the output signal from the above-mentioned maximum detection means, and the above-mentioned minimum value detection means, and to detect the amplitude of a profile.

[0021] A maximum detection means by which the profile compensator of the 3rd invention (claim 4) detects maximum from two or more pixel signals near the attention pixel of an input video signal, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detection means, the above-mentioned minimum value detection means, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and the first addition means adding the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, The nonlinear-processing means which considers the output signal of the addition means of the above first as an input, and a profile amplitude detection means to consider an output signal as an input from the output signal from the above-mentioned maximum detection means, and the above-mentioned minimum value detection means, and to detect the amplitude of a profile, A profile extraction means to consider two or more pixel signals near the attention pixel of an input video signal as an input, and to extract a profile correction component; It has the second addition means adding the output signal and the above-mentioned input video signal from the above-mentioned profile extraction means, and a mixed means to mix the output signal from the addition means of the above second, and the output signal of the above-mentioned nonlinear-processing means.

[0022] The profile compensator of the 4th invention (claim 8) considers the discretization video signal of a sampling period t1 as an input, and is equipped with a sampling-period conversion means to change a sampling period into a sampling period t2, and the profile correction means which considers the discretization video signal changed into the sampling period t2 as an input.

[0023]

[Function] When maximum and the minimum value are detected in the same orientation to an attention pixel, in order not to perform profile correction according to the 1st invention, geometric structure of subject-copy image original is not lost.

[0024] According to the 2nd invention, in the fraction with a large profile amplitude, since the amount of correction is set up small, distortion produced with the profile of the orientation of slant can be oppressed.

[0025] According to the 3rd invention, since a profile amplitude outputs a high region frequency highlight type profile correction signal in a large fraction, distortion produced with the profile of the orientation of slant can be oppressed, and the profile correction effect can also be acquired.

[0026] Since according to the 4th invention profile correction processing is performed after changing a sampling period, distortion produced with the profile of the orientation of slant can be oppressed.

[0027]

[Example] It explains, referring to a drawing about the profile compensator of one example of this invention below. Drawing 1 is drawing showing the configuration of the profile compensator in

the 1st example of this invention.
[0028] drawing 1 -- setting -- 1 -- the input terminal of a video signal, and 2 -- an output terminal and 10 -- an average circuit and 20 -- a subtractor and 30a, 30b, 30c, and 30d -- for a minimum value detector and 70, as for an adder and 90, a gain-adjustment machine and 80 are [a 1 pixel retardation machine and 40 / a maximum detector and 50 / a nonlinear-processing circuit and 100] position detectors The point different from the conventional example shown in drawing 13 is a point of having formed the position detector 100.
[0029] The output signal of an input video signal and the 1 pixel retardation machines 30a, 30b, 30c, and 30d, the maximum detector 40, and the minimum value detector 50 is inputted into the position detector 100. The output signal of the position detector 100 is supplied to the gain-adjustment machine 70.
[0030] The operation is explained about the profile compensator of drawing 1 below using view 2 . The signal in each point a-m of drawing 1 corresponds to the wave shown in drawing 2 (a) - (m).
[0031] For example, when the signal of the shape of same trapezoid as drawing 15 (**) is inputted, on a - e each point, the wave of drawing 2 (a) - (e) is acquired, and the output signal of the maximum detector 40 and the minimum value detector 50 becomes like drawing 2 (f) and (g). Therefore, as an output signal of the average circuit 10, the wave of drawing 2 (h) is acquired and the wave of drawing 2 (i) is acquired as an output signal of a subtractor 20. The operation so far is the same as that of what was explained in the conventional example.
[0032] Here, the output signal (f) of input signal and 1 pixel retardation machines [30a 30b, 30c, and 30d] output signal (a) - (e) and the maximum detector 40, and the minimum value detector 50 and (g) are supplied to the position detector 100, respectively.
[0033] The position detector 100 consists of a circuit of drawing 3 . As for 101a, 101b, 101c, 101d, 101e, 101f, 101g, 101h, 101i, and 101j, in drawing 3 , a comparator and 120 are logical circuits. First, (g) is compared with drawing 2 (a) - (e) in comparators 101a-101e, when equal, by the logical value, "1" and when not equal, "0" is outputted by the logical value, and a logical circuit 120 is supplied as the comparison result A1 - A5, respectively.
[0034] Moreover, in comparators 101f-101j, (f) is compared with drawing 2 (a) - (e), and a logical circuit 120 is supplied as the comparison result B1 - B5, respectively. a logical circuit 120 -- for example, (Table 1) -- the time of fulfilling either of eight kinds of shown combination -- a logical value -- "0" -- outputting -- other than this -- coming out -- "1" is outputted
[0035]
[Table 1]

組み合わせ		A1 / B1	A2 / B2	A3 / B3	A4 / B4	A5 / B5
1	A	0	1	0	0	0
	B	0	1	0	0	0
2	A	0	1	0	0	0
	B	1	0	0	0	0
3	A	1	0	0	0	0
	B	0	1	0	0	0
4	A	1	0	0	0	0
	B	1	0	0	0	0
5	A	0	0	0	1	0
	B	0	0	0	1	0
6	A	0	0	0	1	0
	B	0	0	0	0	1
7	A	0	0	0	0	1
	B	0	0	0	1	0
8	A	0	0	0	0	1
	B	0	0	0	0	1

[0036] The logic shown in (Table 1) is controlled not to perform profile correction as an error, when maximum and the minimum value are detected in the same orientation to an observing

point, then an observing point in the signal in c points of ~~drawing 1~~ . This logic signal (m) is supplied to the gain-adjustment circuit 70, and when a logic signal is "0", it is controlled so that gain becomes zero. Therefore, as an output signal of the gain-adjustment machine 70, the wave of ~~drawing 2~~ (j) is acquired, it adds with the wave of ~~drawing 2~~ (c), and the wave of ~~drawing 2~~ (k) is acquired. In the nonlinear-processing circuit 90, the nonlinear processing of the wave of drawing 2 (k) is carried out like the conventional example according to the wave of ~~drawing 2~~ (f) and the ~~drawing 2~~ (g), and it acquires the wave of ~~drawing 2~~ (l). ~~drawing 2~~ (l) **** -- expiring -- kana -- distortion by the upper low fraction of a trapezoid-like wave is not produced like

[0037] According to the profile compensator in the 1st example of this invention, profile correction can be performed as mentioned above, without losing the geometric structure of a subject-copy image also to a certain specific profile picture image.

[0038] In addition, the combination of a logical circuit is not having restricted to this, but is using various combination, and the control of it with a more high precision is attained.

[0039] ~~Drawing 4~~ is drawing showing the configuration of the profile compensator in the 2nd example of this invention. The point different from the conventional example shown in drawing 13 is a point that the profile amplitude detector 110 was added. The output signal of the maximum detector 40 and the output signal of the minimum value detector 50 are supplied to the profile amplitude detector 110, and the output signal of the profile amplitude detector 110 is supplied to the gain-adjustment machine 70.

[0040] An operation of the profile compensator in the 2nd example of ~~drawing 4~~ is explained using ~~drawing 5~~ . For example, when the profile signal (~~drawing 5~~ (A), (B)) with which an amplitude is different like the case where it is shown in ~~drawing 16~~ is inputted, the wave in an observing point is ~~drawing 5~~ (c), and the output signal of the maximum detector 40 corresponding to it and the output signal of the minimum value detector 50 become like the ~~drawing 5~~ (f) and (g), respectively. Therefore, the signal wave form of ~~drawing 5~~ (i) is obtained as an output signal of a subtractor 20. The operation so far is the same as that of the profile compensator of the conventional example.

[0041] The signal of the ~~drawing 5~~ (f) and (g) is supplied also to the profile amplitude detector 110 here. The profile amplitude detector 110 consists of a circuit of ~~drawing 6~~ .

[0042] In ~~drawing 6~~ , 111 is a subtractor and 112 is a coefficient generator. The ~~drawing 5~~ (f) and the signal wave form of (g) which were inputted in ~~drawing 6~~ are subtracted in a subtractor 111, turn into the signal wave form shown in ~~drawing 5~~ (o), and are supplied to the coefficient generator 112. That is, the subtraction result of a subtractor 111 shows the size of a profile amplitude. The coefficient generator 112 outputs the coefficient kn which sets up the gain of the gain-adjustment machine 70 according to the size of the inputted profile amplitude.

[0043] The coefficient generator 112 consists of a comparator, and as compared with the threshold set up beforehand, when larger than a threshold, a coefficient kn is set to kn=0.5. A parvus case sets a coefficient kn to kn=1.0 from a threshold.

[0044] Therefore, after carrying out amplitude adjustment of the output wave (i) of a subtractor 20 as shown in ~~drawing 5~~ (j), and adding it with an attention pixel signal (c) with an adder 80, it is supplied to the nonlinear-processing circuit 150. Like the conventional example, according to the output signal (f) of the maximum detector 40, and the output signal (g) of the minimum value detector 50, the nonlinear processing of the nonlinear-processing circuit is carried out, and it acquires the profile correction wave shown in ~~drawing 5~~ (l) as an output signal.

[0045] this wave **** -- expiring -- kana -- the correction effect is weakened by making gain small like about the profile in which contrast has a profile amplitude greatly, and distortion produced especially with the profile of the orientation of slant is suppressed Moreover, to the parvus profile of a profile amplitude, profile correction can be performed as the conventional example.

[0046] According to the profile compensator of the 2nd example of this invention, profile correction can be performed as mentioned above, without producing distortion also to the profile of the orientation of slant of what amplitude.

[0047] In addition, the coefficient of a coefficient generator is not having restricted to two kinds, 0.5 and 1.0, and may set up other values. Moreover, according to the size of a profile amplitude, you may control on a multi-stage story.

[0048] ~~Drawing 7~~ is drawing showing the configuration of the profile compensator in the 3rd example of this invention. The point different from the 2nd example shown in ~~drawing 4~~ is a point that the profile extraction circuit 120, the gain-adjustment machine 130, the adder 140, and the mixed circuit 150 are added. ~~Drawing 7~~ a, b, c, d, and the signal of e points are supplied to the profile extraction circuit 120, and the output signal of the profile extraction circuit 120 is supplied to the gain-adjustment machine 130. The output signal of the gain-adjustment machine 130 is

supplied to one input terminal of an adder 140. The signal of c points is supplied to the input terminal, and, as for an addition result, while I will accept it adder 140 is supplied to one input terminal of the mixed circuit 150. The output signal of the nonlinear-processing circuit 90 is supplied to an input terminal, and, as for the mixed circuit 150, while I will accept it mixed circuit 150 is controlled by the output signal of the profile amplitude detector 110. The output signal of the mixed circuit 150 is supplied to an output terminal 2.

[0049] An operation of the profile compensator in the 3rd example of ~~drawing 7~~ is explained using ~~drawing 8~~ . For example, when the profile signal (~~drawing 8~~ (A), (B)) with which an amplitude is different is inputted like the case where it is shown in ~~drawing 16~~ , the wave in an observing point is ~~drawing 8~~ (c), and the profile correction signal with which the output signal of the nonlinear-processing circuit 90 received profile inclination correction type processing as shown in ~~drawing 8~~ (l) is acquired. The operation so far is the same as that of what was explained in the conventional example.

[0050] ~~Drawing 7~~ a, b, c, d, and the signal in e points are supplied to the profile extraction circuit 120. The profile extraction circuit 120 consists of a circuit shown in ~~drawing 9~~ . As for 121a, 121b, and 121c, in ~~drawing 9~~ , a coefficient multiplier and 122 are multi-input adders. If the coefficient of the coefficient multipliers 121a, 121b, and 121c is set as $k1=-1/4$, $k2=1/2$, and $k3=-1/4$ and a multiplication result is added with the multi-input adder 122, the wave of ~~drawing 8~~ (q) will be acquired as an addition result. That is, the profile extraction circuit 120 is the high pass type VCF known well, and extracts a profile component.

[0051] After carrying out amplitude adjustment of the output signal of the profile extraction circuit 120 with the gain-adjustment vessel 140, it is added with the HARASHIN number (c) in an adder 140, and acquires the high region frequency highlight type profile correction wave with the undershooting which is shown in ~~drawing 8~~ (r) as an addition output, and an over shoot.

[0052] The profile amplitude detector 110 is the same configuration as ~~drawing 6~~ fundamentally, and the signal shown in ~~drawing 8~~ (o) as an output signal of the subtractor 111 of ~~drawing 6~~ is acquired. The coefficient generator 112 outputs the coefficient kn which controls the mixed circuit 150 according to an input signal amplitude. For example, from kn=1.0 and the threshold 1, when [that a parvus case is larger than the threshold 1 which an amplitude set up beforehand] a parvus case is larger than kn=0.5 and the threshold 2 from a threshold 2, it is referred to as kn=0. The mixed circuit 150 calculates according to (-one number) a coefficient kn.

[0053]

[Equation 1]

$$\text{混合出力} = kn \times \ell + (1 - kn) \times r$$

$$0 \leqq kn \leqq 1$$

[0054] According to (the-one number), kn enlarges mixed proportion of the high region frequency highlight type profile correction signal shown in ~~drawing 8~~ (r), and outputs it so that it is as large as the parvus, i.e., a profile amplitude. Therefore, the signal shown in ~~drawing 8~~ (s) as an output signal of the mixed circuit 150 is acquired.

[0055] this wave -- since -- expiring -- kana -- oval occurrence can be suppressed especially in the profile of the orientation of slant, and the profile correction effect can also be taken out with enlarging proportion of a high region frequency highlight type profile correction signal about the profile in which contrast has a profile amplitude greatly like Distortion is not generated, even if it processes the profile of the orientation of slant, since all high region frequency highlight type profile correction is alignment processings. Moreover, to the parvus profile of a profile amplitude, profile inclination correction type profile correction is performed.

[0056] According to the profile compensator of the 3rd example of this invention, profile correction can be performed as mentioned above, without producing distortion also to the profile of the orientation of slant of what amplitude.

[0057] In addition, the mixed proportion of a mixed circuit is not having restricted to three phases, and may be set as a multi-stage story according to the size of a profile amplitude. Moreover, the configuration of a profile extraction circuit may not be having restricted to this, but may be the thing of what configuration, if the high pass type frequency characteristic is realized.

[0058] ~~Drawing 10~~ is drawing showing the configuration of the profile compensator in the 4th example of this invention. In ~~drawing 10~~ , 200 is a sampling-rate converter and 400 is the profile correction section. The profile correction section is the same configuration as fundamentally as the conventional profile compensator shown in ~~drawing 13~~ , and the point different from the conventional example is a point which has placed and changed the 1 pixel retardation machine of the conventional example to the 4 pixel retardation machines 300a, 300b, 300c, and 300d.

[0059] About the profile compensator of ~~view 10~~ , the operation is explained below, using ~~drawing 11~~ . First, as an input video signal is shown in ~~drawing 11~~ (a), suppose that it is sampling **** sampled by the sampling period Ts (sec) per pixel, and this sampled-value train is supplied to the sampling-rate converter 200. The sampling-rate converter 200 consists of a circuit shown in ~~drawing 12~~ . In ~~drawing 12~~ , 201 is a zero insertion circuit and 202 is an interpolation circuit.
[0060] First, sampling **** of ~~drawing 11~~ (a) is supplied to the zero insertion circuit 201. For example, when changing the original sampling period Ts (sec) to one fourth, in the zero insertion circuit 201, the three zero points are inserted at Ts/4 spacing between each sampling value sampled by the sampling period Ts. The zero point inserted as shown in ~~drawing 11~~ (b) by inserting the zero point can be included, and the sampling period between each pixel is changed into Ts/4. As shown in ~~drawing 11~~ (b), sampling **** from which the zero insertion was carried out and the sampling period was changed into Ts/4 is supplied to an interpolation circuit 202. An interpolation circuit 120 is for example, a load adder, the inserted zero point is interpolated by load addition using the original sampling value of the circumference, and sampling **** of sampling period Ts / 4 which are shown in ~~drawing 11~~ (c) is obtained. Sampling **** of sampling period Ts / 4 is supplied to the profile correction section 400. The profile correction section 400 is processed like the profile correction circuit explained in the conventional example, and the profile correction wave (sampling ****) shown in ~~drawing 11~~ (d) as an output signal of the profile correction section 400 is acquired.
[0061] this drawing **** -- expiring -- kana -- distortion produced when profile correction is carried out to a slanting profile, since the spacing (the minimum shift width of face) of 1 pixel is set to one fourth like compared with the profile compensator of the conventional example can be suppressed
[0062] Profile correction can be performed, without producing distortion also to the profile of the orientation of slant as mentioned above according to the profile compensator in the 4th example of this invention.
[0063] In addition, a sampling-rate converter is not having restricted to this configuration, and as long as the sampling period after conversion becomes smaller than the sampling period before conversion, it may use the thing of what configuration. Moreover, what is necessary is for a 4 pixel retardation machine not to be what was restricted to this value, and just to set it up arbitrarily in accordance with the sampling period after conversion.
[0064]
[Effect of the Invention] A maximum detection means to detect maximum as mentioned above from the pixel signal of the plurality [this invention] near the attention pixel of an input video signal, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detector, the above-mentioned minimum value detector, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and an addition means to add the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, The nonlinear-processing means which considers the output signal of the above-mentioned addition means as an input, two or more pixel signals near [above-mentioned] the attention pixel, the output signal from the above-mentioned maximum detection means, and the output signal from the above-mentioned minimum value detection means are considered as an input. A quality profile correction picture image can be acquired by establishing a position detection means to detect the occurrence position of maximum and the minimum value, without losing the geometric structure of subject-copy image original.
[0065] Moreover, a maximum detection means to detect maximum from two or more pixel signals near the attention pixel of an input video signal, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detection means, the above-mentioned minimum value detection means, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and an addition means to add the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, By establishing the nonlinear-processing means which considers the output signal of the above-mentioned addition means as an input, and a profile amplitude detection means to consider an output signal as an input from the output signal from the above-mentioned maximum detection means, and the above-mentioned minimum value detection means, and to detect the amplitude of a profile The quality profile correction picture

image which oppressed distortion produced with the profile of the orientation of slant can be acquired.
[0066] Furthermore, a maximum detection means to detect maximum from two or more pixel signals near the attention pixel of an input video signal, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detection means, the above-mentioned minimum value detection means, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and the first addition means adding the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, The nonlinear-processing means which considers the output signal of the addition means of the above first as an input, and a profile amplitude detection means to consider an output signal as an input from the output signal from the above-mentioned maximum detection means, and the above-mentioned minimum value detection means, and to detect the amplitude of a profile, A profile extraction means to consider two or more pixel signals near the attention pixel of an input video signal as an input, and to extract a profile correction component, By having the second addition means adding the output signal and the above-mentioned input video signal from the above-mentioned profile extraction means, and a mixed means to mix the output signal from the addition means of the above second, and the output signal of the above-mentioned nonlinear-processing means While distortion produced with the profile of the orientation of slant is oppressed, the quality profile correction picture image which added undershooting and the over shoot can be acquired.
[0067] Furthermore, distortion produced with the profile of the orientation of slant can be oppressed by having a sampling-period conversion means to change the discretization video signal of a sampling period t1 into a sampling period t2, and the profile correction means which considers the discretization video signal changed into the sampling period t2 as an input.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the profile compensator in the 1st example of this invention
[Drawing 2] It is a wave form chart in order to explain an operation of the profile compensator in the 1st example of this invention.
[Drawing 3] The block diagram of a position detector
[Drawing 4] The block diagram of the profile compensator in the 2nd example of this invention
[Drawing 5] (A) is a wave form chart in order to explain an operation of the profile compensator in the 2nd example.
(B) is a wave form chart in order to explain an operation of this profile compensator.
[Drawing 6] The block diagram of a profile amplitude detector
[Drawing 7] The block diagram of the profile compensator in the 3rd example of this invention
[Drawing 8] (A) is a wave form chart in order to explain an operation of the profile compensator in the 3rd example.
(B) is a wave form chart in order to explain an operation of this profile compensator.
[Drawing 9] The block diagram of a profile extraction circuit
[Drawing 10] The block diagram of the profile compensator in the 4th example of this invention
[Drawing 11] It is a wave form chart in order to explain an operation of the profile compensator in the 4th example of this invention.
[Drawing 12] The block diagram of a sampling-rate converter
[Drawing 13] The block diagram of the profile compensator in the conventional example
[Drawing 14] The wave form chart for explaining an operation of the profile compensator in the conventional example
[Drawing 15] The wave form chart for explaining the technical probrem of the profile compensator in the conventional example
[Drawing 16] (A) is a wave form chart for explaining the technical probrem of the profile compensator in the conventional example.
(B) is a wave form chart for explaining the technical probrem of this profile compensator.
[Drawing 17] The wave form chart for explaining the technical probrem of the profile compensator in the conventional example
[Description of Notations]
1 Input Terminal
2 Output Terminal
10 Average Circuit
20 Subtractor
30 1 Pixel Retardation Machine
40 Maximum Detector
50 Minimum Value Detector
70 Gain-Adjustment Machine
80 Adder
90 Nonlinear-Processing Circuit
100 Position Detector
110 Profile Amplitude Detector
120 Profile Extraction Circuit
130 Gain-Adjustment Machine
140 Adder
150 Mixed Circuit
200 Sampling-Rate Converter
300 Arithmetic Circuit
400 Profile Correction Section

[Translation done.]

CLAIMS

[Claim(s)]

[Claim 1] A maximum detection means to be the profile compensator which emphasizes the profile of a picture image, and to detect maximum from two or more pixel signals near the attention pixel of an input video signal, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detector, the above-mentioned minimum value detector, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and an addition means to add the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, The nonlinear-processing means which considers the output signal of the above-mentioned addition means as an input, two or more pixel signals near [above-mentioned] the attention pixel, the output signal from the above-mentioned maximum detection means, and the output signal from the above-mentioned minimum value detection means are considered as an input. Have a position detection means to detect the occurrence position of maximum and the minimum value, and the above-mentioned amplitude adjustment means is controlled using the output signal of the above-mentioned position detection means. And the profile compensator characterized by controlling the above-mentioned nonlinear-processing means using the output signal of the above-mentioned maximum detection means, and the output signal of the above-mentioned minimum value detection means.

[Claim 2] A position detection means is a profile compensator according to claim 1 characterized by to have two or more second comparison meanses compare the amplitude of two or more first comparison meanses to compare the amplitude of two or more pixel signals near the attention pixel, and the output signal of a maximum detection means, two or more pixel signals near [above-mentioned] the attention pixel, and the output signal of a minimum value detection means, and the logical operation means which considers the two or more above-mentioned firsts and second comparison results from a comparison means as an input.

[Claim 3] A maximum detection means to be the profile compensator which emphasizes the profile of a picture image, and to detect maximum from two or more pixel signals near the attention pixel of an input video signal, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detection means, the above-mentioned minimum value detection means, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and an addition means to add the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, It has the nonlinear-processing means which considers the output signal of the above-mentioned addition means as an input, and a profile amplitude detection means to consider an output signal as an input from the output signal from the above-mentioned maximum detection means, and the above-mentioned minimum value detection means, and to detect the amplitude of a profile. The profile compensator characterized by controlling the above-mentioned amplitude adjustment means using the output signal of the above-mentioned profile amplitude detection means, and controlling the above-mentioned nonlinear-processing means using the output signal of the above-mentioned maximum detection means, and the output signal of the above-mentioned minimum value detection means.

[Claim 4] A maximum detection means to be the profile compensator which emphasizes the profile of a picture image, and to detect maximum from two or more pixel signals near the attention pixel of an input video signal, A minimum value detection means to detect the minimum

value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detection means, the above-mentioned minimum value detection means, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and the first addition means adding the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, The nonlinear-processing means which considers the output signal of the addition means of the above first as an input, and a profile amplitude detection means to consider an output signal as an input from the output signal from the above-mentioned maximum detection means, and the above-mentioned minimum value detection means, and to detect the amplitude of a profile, A profile extraction means to consider two or more pixel signals near the attention pixel of an input video signal as an input, and to extract a profile correction component, The second addition means adding the output signal and the above-mentioned input video signal from the above-mentioned profile extraction means, It has a mixed means to mix the output signal from the addition means of the above second, and the output signal of the above-mentioned nonlinear-processing means. The profile compensator characterized by controlling the above-mentioned mixed means using the output signal of the above-mentioned profile amplitude detection means, and controlling the above-mentioned nonlinear-processing means using the output signal of the above-mentioned maximum detection means, and the output signal of the above-mentioned minimum value detection means.
[Claim 5] A profile amplitude detection means is a profile compensator according to claim 3 or 4 characterized by having a subtraction means to take the difference of the output signal from a maximum detection means, and the output signal from a minimum value detection means, and a coefficient occurrence means to generate a coefficient on the basis of the subtraction result from the above-mentioned subtraction means.
[Claim 6] A profile extraction means is a profile compensator according to claim 4 characterized by being a high region frequency transit type **** means.
[Claim 7] An operation means is a profile compensator given in either of the claims 1, 3, or 4 characterized by having an equalization means to take an average of the output signal from a maximum detection means, and the output signal from a minimum value detection means, and a subtraction means to take the difference of an input video signal and the output signal from the above-mentioned equalization means.
[Claim 8] The profile compensator which is a profile compensator which emphasizes the profile of a picture image, considers the discretization video signal of a sampling period t1 as an input, and is characterized by having a sampling-period conversion means to change a sampling period into a sampling period t2, and the profile correction means which considers the discretization video signal changed into the sampling period t2 as an input.
[Claim 9] A maximum detection means to detect maximum from two or more pixel signals near the attention pixel of the discretization video signal from which the profile correction means was changed into the sampling period t2, A minimum value detection means to detect the minimum value from two or more pixel signals near the attention pixel of an input video signal, The operation means which considers the above-mentioned maximum detection means, the above-mentioned minimum value detection means, and the above-mentioned input video signal as an input, and carries out data processing, The amplitude adjustment means which considers the output signal of the above-mentioned operation means as an input, and an addition means to add the output signal and the above-mentioned input video signal of the above-mentioned amplitude adjustment means, The profile compensator according to claim 8 characterized by having the nonlinear-processing means which considers the output signal of the above-mentioned addition means as an input, and controlling the above-mentioned nonlinear-processing means using the output signal of the above-mentioned maximum detection means, and the output signal of the above-mentioned minimum value detection means.
[Claim 10] The discretization period t2 is a profile compensator according to claim 8 characterized by being smaller than the discretization period t1.

[Translation done.]

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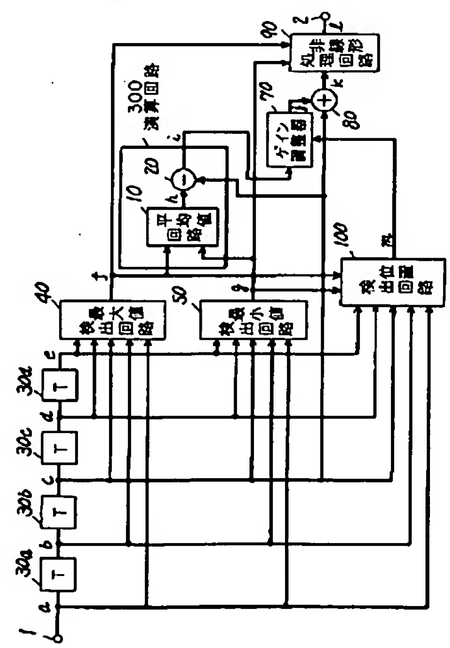
最終頁に続く

(54)【発明の名称】　輪郭補正装置

(57)【要約】

【目的】　本発明は、画像の輪郭を補正し鮮鋭度を向上させるための輪郭補正装置に関するもので、ｱﾝﾀﾞｰｼｭｰﾄおよびｵｰﾊﾞｰｼｭｰﾄを付加することなく輪郭補正が行える輪郭補正装置を提供することを目的とする。

【構成】　演算回路300の出力信号として、輪郭補正成分が得られる。位置検出回路100は最大値および最小値の発生位置を検出する。位置検出回路100はある特定の構造の輪郭において最大値および最小値が注目点に対して同一方向で発生した場合、ｹﾞｲﾝ調整器70のｹﾞｲﾝを零とする。その他の輪郭に対してはｹﾞｲﾝを有意な値に設定する。以上の動作により原画像本来の幾何学的構造を失うことなく輪郭補正を行うことができる。



1　　2

【特許請求の範囲】

【請求項1】画像の輪郭を強調する輪郭補正装置であって、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出回路と前記最小値検出回路と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する加算手段と、前記加算手段の出力信号を入力とする非線形処理手段と、前記注目画素近傍の複数の画素信号と前記最大値検出手段からの出力信号と前記最小値検出手段からの出力信号を入力とし、最大値と最小値の発生位置を検出する位置検出手段とを備え、前記位置検出手段の出力信号を用いて前記振幅調整手段を制御し、かつ前記最大値検出手段の出力信号と前記最小値検出手段の出力信号を用いて前記非線形処理手段を制御することを特徴とする輪郭補正装置。

【請求項2】位置検出手段は、注目画素近傍の複数の画素信号と最大値検出手段の出力信号の振幅を比較する複数の第一の比較手段と、前記注目画素近傍の複数の画素信号と最小値検出手段の出力信号の振幅を比較する複数の第二の比較手段と、前記複数の第一および第二の比較手段からの比較結果を入力とする論理演算手段とを備えたことを特徴とする請求項1記載の輪郭補正装置。

【請求項3】画像の輪郭を強調する輪郭補正装置であって、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出手段と前記最小値検出手段と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する加算手段と、前記加算手段の出力信号を入力とする非線形処理手段と、前記最大値検出手段からの出力信号と前記最小値検出手段から出力信号を入力とし輪郭の振幅を検出する輪郭振幅検出手段とを備え、前記輪郭振幅検出手段の出力信号を用いて前記振幅調整手段を制御し、かつ前記最大値検出手段の出力信号と前記最小値検出手段の出力信号を用いて前記非線形処理手段を制御することを特徴とする輪郭補正装置。

【請求項4】画像の輪郭を強調する輪郭補正装置であって、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出手段と前記最小値検出手段と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する第一の加算手段と、前記第一の加算手段の出力信号を入力とする非線形処理手段と、前記最大値検出手段からの出力信号と前記最小値検出手段から出力信号を入力とし輪郭の振幅を検出する輪郭振幅検出手段と、入力映像信号の注目画素近傍の複数の画素信号を入力とし輪郭補正成分を抽出する輪郭抽出手段と、前記輪郭抽出手段からの出力信号と前記入力映像信号を加算する第二の加算手段と、前記第二の加算手段からの出力信号と前記非線形処理手段の出力信号を混合する混合手段とを備え、前記輪郭振幅検出手段の出力信号を用いて前記混合手段を制御し、かつ前記最大値検出手段の出力信号と前記最小値検出手段の出力信号を用いて前記非線形処理手段を制御することを特徴とする輪郭補正装置。

【請求項5】輪郭振幅検出手段は、最大値検出手段からの出力信号と最小値検出手段からの出力信号の差をとる減算手段と、前記減算手段からの減算結果をもとに係数を発生する係数発生手段とを備えたことを特徴とする請求項3または4記載の輪郭補正装置。

【請求項6】輪郭抽出手段は、高域周波数通過型濾波手段であることを特徴とする請求項4記載の輪郭補正装置。

【請求項7】演算手段は、最大値検出手段からの出力信号と最小値検出手段からの出力信号の平均をとる平均化手段と、入力映像信号と前記平均化手段からの出力信号の差をとる減算手段とを備えたことを特徴とする請求項1、3または4のいずれかに記載の輪郭補正装置。

【請求項8】画像の輪郭を強調する輪郭補正装置であって、標本化周期ｔ１の離散化映像信号を入力とし、標本化周期ｔ２に標本化周期を変換する標本化周期変換手段と、標本化周期ｔ２に変換された離散化映像信号を入力とする輪郭補正手段とを備えたことを特徴とする輪郭補正装置。

【請求項9】輪郭補正手段は、標本化周期ｔ２に変換された離散化映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出手段と前記最小値検出手段と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する加算手段と、前記加算手段の出力信号を入力とする非線形処理手段とを備え、前記最大値検出手段の出力信号と前記最小値検出手段の出力信号を用いて前記非線形処理手段を制御することを特徴とする請求項8記載の輪郭補正装置。

【請求項１０】離散化周期ｔ２は離散化周期ｔ１より小さいことを特徴とする請求項8記載の輪郭補正装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、画像の輪郭を補正し、鮮鋭度を向上させるための輪郭補正装置に関する。

3

【０００２】

【従来の技術】画像の輪郭部分にプリシュート、オーバーシュートを付加することなく鮮鋭度を改善する手段として、特願平４－４２５５７号に記載の輪郭補正装置がある。

【０００３】従来の輪郭補正装置の一例を図１３に示す。図１３において、１は映像信号の入力端子、２は出力端子、１０は平均値回路、２０は減算器、３０ａ、３０ｂ、３０ｃ、３０ｄは１画素遅延器、４０は最大値検出回路、５０は最小値検出回路、７０はゲイン調整器、８０は加算器、９０は非線形処理回路、３００は演算回路である。

【０００４】入力映像信号は１画素遅延器３０ａ、３０ｂ、３０ｃ，３０ｄにより遅延される。入力映像信号、１画素遅延回路３０ａ、３０ｂ、３０ｃ，３０ｄの出力信号は、最大値検出回路４０、最小値検出回路５０にそれぞれ供給される。１画素遅延器３０ｂの出力信号は減算器２０の一方の入力端子および加算器８０の一方の入力端子にそれぞれ供給される。最大値検出回路４０の出力信号は、平均値回路１０および非線形処理回路９０にそれぞれ供給される。

【０００５】最小値検出回路５０の出力信号は平均値回路１０および非線形処理回路９０にそれぞれ供給される。平均値回路１０の出力信号は減算器２０のもう一方の入力端子に供給される。減算器２０の減算結果はゲイン調整器７０に供給され、ゲイン調整器７０の出力信号は加算器８０のもう一方の入力端子に供給される。加算器８０の加算結果は非線形処理回路９０において、最大値検出回路４０からの出力信号および最小値検出回路５０からの出力信号にしたがって非線形処理され出力端子２より出力される。

【０００６】以上のように構成された従来の輪郭補正装置の動作について、図１４に示す波形図を参照にしながら説明する。図１４において（ａ）～（ｌ）に示す信号波形は図１３における各点ａ～ｌで得られる信号波形に対応している。

【０００７】まず、図１３において入力端子１より図１４（ａ）に示すような輪郭を持つ映像信号が入力されているとする。この映像信号は１画素遅延器３０ａ、３０ｂ、３０ｃ、３０ｄにより遅延されｂ，ｃ，ｄ，ｅ各点において図１４（ｂ）～（ｅ）に示す信号波形を得る。最大値検出回路４０は入力信号ａ～ｅの大きさを比較して最大の値を出力する。したがってｆ点において図１４（ｆ）に示す信号波形が得られる。

【０００８】最小値検出回路５０は入力された入力信号ａ～ｅの大きさを比較して最小の値を出力する。したがってｇ点において図１４（ｇ）に示す信号波形が得られる。図１４（ｆ）と（ｇ）に示す信号は平均値回路１０で平均値がとられ図１４（ｈ）に示す信号波形を得る。

【０００９】減算器２０においては、１画素遅延器３０ｂの出力信号ｃからｈ点での信号が減算され図１４（ｉ）の信号波形を得る。ゲイン調整器７０のゲインを、たとえば１に設定すると、その出力信号は図１４（ｊ）に示す信号波形となり、加算器８０において、図１４（ｃ）に示す１画素遅延器３０ｂからの出力信号と加算すれば加算器８０の加算結果として図１４（ｋ）に示す信号波形を得る。この信号は非線形処理回路９０において最大値検出回路４０および最小値検出回路５０の出力信号にしたがって非線形処理される。

4

【００１０】例えば、信号波形（ｆ）、（ｋ），（ｌ）の大きさを比較し、信号（ｋ）が信号（ｆ）より大きい場合は信号（ｆ）を出力する。また、信号（ｋ）が信号（ｇ）より小さい場合は信号（ｇ）を出力する。それ以外の場合は信号（ｋ）を出力する。つまり検出された最大値あるいは最小値を用いて振幅が制限される。これに従えば、非線形処理回路９０の出力信号として、図１４（ｌ）に示すような輪郭の勾配が急峻になった映像信号を得る。

【００１１】このように従来の輪郭補正装置によれば、アンダーシュート、オーバーシュートを付加することなく鮮鋭度を改善することができる（以下の説明の都合上、上述したような輪郭補正方法を輪郭勾配補正型と記述する。）。

【００１２】

【発明が解決しようとする課題】しかしながら上述したような構成では、ある特定の輪郭画像に対して原画像の幾何学的構造を失ってしまうという欠点を有していた。

【００１３】たとえば図１５（イ）に示すような台形状の輪郭信号に対して従来の輪郭補正処理を行う場合、図１５（イ）の信号に対応する最大値検出結果として、図１５（ロ）の信号が得られる。また最小値検出結果として図１５（ハ）の信号が得られる。したがって平均値信号は図１５（ニ）の信号となり、この平均値信号を原信号（イ）から減算した結果は、図１５（ホ）の信号となり、これを原信号（イ）に加算すると図１５（ヘ）の信号となる。図１５（ヘ）の信号は最大値検出結果および最小値検出結果に従って非線形制御され、結果として図１５（ト）の信号を得る。この波形より明らかなように台形状の輪郭の上底部分が平坦になり原画像の幾何学的構造を失ってしまう。

【００１４】そこで本発明は、上記課題を鑑み原画像の幾何学的構造を失うことなく輪郭補正が行える輪郭補正装置を提供するものである。

【００１５】さらに上述したような構成では、振幅の大きい輪郭に対して歪が生じるという欠点を有していた。

【００１６】例えば、図１６（イ）に示すような輪郭振幅の異なる輪郭信号（（Ａ）（Ｂ））に従来例の輪郭補正処理を行った場合、輪郭補正画像は図１６（ロ）のようになる。特に振幅が大きい輪郭については非線形処理において抑圧される振幅が大きいため鮮鋭度改善の効果

は大きいが、それにともなって歪も大きくなる。このような現象は特にテレビジョン信号などの様に、ラスタ走査によって表示される画像において、たとえば図１７（イ）のような斜め方向に輪郭を持つ画像を補正した場合に顕著に現れる。図１７（イ）の各走査線に対応する波形は図１７（ロ）のようになっている。

【００１７】図１７（イ）の画像を輪郭補正処理すると図１７（ハ）に示すような画像となり、斜め方向の輪郭部分で階段状の歪を生じる。図１７（ハ）の各走査線に対応する波形は図１７（ニ）のようになっている。図１７（ニ）より明かなように、歪は斜め線を表示するための走査線ごとの最小の位相シフト量が１画素単位であり１画素以内のシフト量は表現できないことに起因しており、輪郭振幅が大きく輪郭補正効果が大きいほど顕著になる。また輪郭振幅が小さい場合はもともとコントラストが小さいため歪は目だちにくい。

【００１８】そこで本発明は、上記課題を鑑み斜め方向の輪郭であっても歪を生じることなく輪郭補正が行える輪郭補正装置を提供するものである。

【００１９】

【課題を解決するための手段】上記目的を達するため、第１の発明（請求項１）の輪郭補正装置は、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出回路と前記最小値検出回路と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する加算手段と、前記加算手段の出力信号を入力とする非線形処理手段と、前記注目画素近傍の複数の画素信号と前記最大値検出手段からの出力信号と前記最小値検出手段からの出力信号を入力とし、最大値と最小値の発生位置を検出する位置検出手段とを備えたものである。

【００２０】第２の発明（請求項３）の輪郭補正装置は、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出手段と前記最小値検出手段と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する加算手段と、前記加算手段の出力信号を入力とする非線形処理手段と、前記最大値検出手段からの出力信号と前記最小値検出手段から出力信号を入力とし輪郭の振幅を検出する輪郭振幅検出手段とを備えたものである。

【００２１】第３の発明（請求項４）の輪郭補正装置は、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出手段と前記最小値検出手段と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する第一の加算手段と、前記第一の加算手段の出力信号を入力とする非線形処理手段と、前記最大値検出手段からの出力信号と前記最小値検出手段から出力信号を入力とし輪郭の振幅を検出する輪郭振幅検出手段と、入力映像信号の注目画素近傍の複数の画素信号を入力とし輪郭補正成分を抽出する輪郭抽出手段と、前記輪郭抽出手段からの出力信号と前記入力映像信号を加算する第二の加算手段と、前記第二の加算手段からの出力信号と前記非線形処理手段の出力信号を混合する混合手段とを備えたものである。

【００２２】第４の発明（請求項８）の輪郭補正装置は、標本化周期ｔ１の離散化映像信号を入力とし、標本化周期ｔ２に標本化周期を変換する標本化周期変換手段と、標本化周期ｔ２に変換された離散化映像信号を入力とする輪郭補正手段とを備えたものである。

【００２３】

【作用】第１の発明によれば、注目画素に対して同一方向で最大値および最小値が検出された場合は輪郭補正を行わないため、原画像本来の幾何学的構造を失うことはない。

【００２４】第２の発明によれば、輪郭振幅が大きい部分では補正量を小さく設定するため、斜め方向の輪郭で生じる歪を抑圧することができる。

【００２５】第３の発明によれば、輪郭振幅が大きい部分では高域周波数強調型の輪郭補正信号を出力するため、斜め方向の輪郭で生じる歪を抑圧することができ、かつ輪郭補正効果も得ることができる。

【００２６】第４の発明によれば、標本化周期を変換してから輪郭補正処理を行うため、斜め方向の輪郭で生じる歪を抑圧することができる。

【００２７】

【実施例】以下本発明の一実施例の輪郭補正装置について図面を参照しながら説明する。図１は本発明の第１の実施例における輪郭補正装置の構成を示す図である。

【００２８】図1において、１は映像信号の入力端子、２は出力端子、１０は平均値回路、２０は減算器、３０ａ、３０ｂ、３０ｃ、３０ｄは1画素遅延器、４０は最大値検出回路、５０は最小値検出回路、７０はゲイン調整器、８０は加算器、９０は非線形処理回路、１００は位置検出回路である。図１３に示す従来例と異なる点は位置検出回路１００を設けている点である。

【００２９】位置検出回路１００には入力映像信号および1画素遅延器３０ａ，３０ｂ，３０ｃ，３０ｄ、最大値検出回路４０、最小値検出回路５０の出力信号が入力される。位置検出回路１００の出力信号はゲイン調整器

７０に供給される。

【００３０】以下図２を用いて図１の輪郭補正装置についてその動作を説明する。図１の各点ａ～ｍにおける信号は図２（ａ）～（ｍ）に示す波形に対応している。

【００３１】たとえば図１５（イ）と同じ台形状の信号が入力された場合、ａ～ｅ各点では図２（ａ）～（ｅ）の波形が得られ、最大値検出回路４０および最小値検出回路５０の出力信号は図２（ｆ）、（ｇ）のようになる。したがって平均値回路１０の出力信号として図２（ｈ）の波形が得られ、減算器２０の出力信号として図２（ｉ）の波形が得られる。ここまでの動作は従来例で説明したものと同じである。

【００３２】ここで、入力信号および１画素遅延器３０ａ、３０ｂ，３０ｃ，３０ｄの出力信号（ａ）～（ｅ）および最大値検出回路４０、最小値検出回路５０の出力信号（ｆ）、（ｇ）はそれぞれ位置検出回路１００に供給されている。

【００３３】位置検出回路１００は、例えば図３の回路で構成される。図３において、１０１ａ、１０１ｂ，１０１ｃ，１０１ｄ，１０１ｅ，１０１ｆ，１０１ｇ，１０１ｈ，１０１ｉ，１０１ｊは比較器、１２０は論理回路である。まず、比較器１０１ａ～１０１ｅにおいて図２（ａ）～（ｅ）と（ｇ）が比較され、等しい場合、例えば論理値で”１”、等しくない場合は論理値で”０”を出力し、比較結果Ａ１～Ａ５としてそれぞれ論理回路１２０に供給される。

【００３４】また比較器１０１ｆ～１０１ｊにおいては、図２（ａ）～（ｅ）と（ｆ）が比較され、比較結果Ｂ１～Ｂ５としてそれぞれ論理回路１２０に供給される。論理回路１２０は、例えば（表１）に示す８通りの組み合わせのいずれかを満たす時のみ論理値で”０”を出力し、それ以外では”１”を出力する。

【００３５】

【表１】

組み合わせ		Ａ１ Ｂ１	Ａ２ Ｂ２	Ａ３ Ｂ３	Ａ４ Ｂ４	Ａ５ Ｂ５
１	Ａ	０	１	０	０	０
	Ｂ	０	１	０	０	０
２	Ａ	０	１	０	０	０
	Ｂ	１	０	０	０	０
３	Ａ	１	０	０	０	０
	Ｂ	０	１	０	０	０
４	Ａ	１	０	０	０	０
	Ｂ	１	０	０	０	０
５	Ａ	０	０	０	１	０
	Ｂ	０	０	０	１	０
６	Ａ	０	０	０	１	０
	Ｂ	０	０	０	０	１
７	Ａ	０	０	０	０	１
	Ｂ	０	０	０	１	０
８	Ａ	０	０	０	０	１
	Ｂ	０	０	０	０	１

【００３６】（表１）に示す論理は図１のｃ点における信号を注目点とすれば、注目点に対して同じ方向で最大値、最小値が検出された場合は誤りとして輪郭補正を行わないように制御する。この論理信号（ｍ）はゲイン調整回路７０に供給されており、論理信号が”０”の場合はゲインが零になるように制御する。したがってゲイン調整器７０の出力信号として図２（ｊ）の波形が得られ、図２（ｃ）の波形と加算して図２（ｋ）の波形を得る。図２（ｋ）の波形は、非線形処理回路９０において従来例と同様に図２（ｆ）と図２（ｇ）の波形にしたがって非線形処理され図２（ｌ）の波形を得る。図２（ｌ）から明かなように、台形状の波形の上低部分での歪は生じない。

【００３７】以上のように本発明の第１の実施例における輪郭補正装置によれば、ある特定の輪郭画像に対しても原画像の幾何学的構造を失うことなく輪郭補正をおこなうことができる。

【００３８】なお、論理回路の組み合わせはこれに限ったことではなく、多様な組み合わせを用いることで、より精度の高い制御が可能となる。

【００３９】図４は、本発明の第２の実施例における輪郭補正装置の構成を示す図である。図１３に示す従来例と異なる点は輪郭振幅検出回路１１０が追加された点である。輪郭振幅検出回路１１０には最大値検出回路４０の出力信号および最小値検出回路５０の出力信号が供給されており、輪郭振幅検出回路１１０の出力信号はゲイン調整器７０に供給される。

【００４０】図４の第２の実施例における輪郭補正装置の動作について、図５を用いて説明する。例えば、図１６に示す場合と同様に振幅の異なる輪郭信号（図５

（A）、（B））が入力された場合、注目点での波形は図５（c）であり、それに対応した最大値検出回路４０の出力信号および最小値検出回路５０の出力信号はそれぞれ図５（f）および（g）のようになる。したがって減算器２０の出力信号として図５（i）の信号波形が得られる。ここまでの動作は従来例の輪郭補正装置と同じである。

【００４１】ここで図５（f）および（g）の信号は輪郭振幅検出回路１１０にも供給されている。輪郭振幅検出回路１１０は、例えば図６の回路で構成される。

【００４２】図６において、１１１は減算器、１１２は係数発生器である。図６において入力された図５（f）および（g）の信号波形は、減算器１１１において減算され、図５（o）に示す信号波形となり、係数発生器１１２に供給される。つまり減算器１１１の減算結果は輪郭振幅の大きさを示している。係数発生器１１２は入力された輪郭振幅の大きさにしたがってゲイン調整器７０のゲインを設定する係数ｋｎを出力する。

【００４３】係数発生器１１２は、たとえば比較器で構成されており、あらかじめ設定した閾値と比較して閾値より大きい場合は係数ｋｎをたとえばｋｎ＝０．５とする。閾値より小さい場合は、係数ｋｎを、たとえばｋｎ＝１．０とする。

【００４４】従って減算器２０の出力波形（i）は図５（j）のように振幅調整され、加算器８０で注目画素信号（c）と加算されたのち、非線形処理回路１５０に供給される。非線形処理回路は、従来例と同様に、最大値検出回路４０の出力信号（f）および最小値検出回路５０の出力信号（g）にしたがって非線形処理され、出力信号として図５（l）に示す輪郭補正波形をえる。

【００４５】この波形から明かなように、輪郭振幅が大きくコントラストのある輪郭についてはゲインを小さくすることで補正効果を弱め、特に斜め方向の輪郭で生じる歪を抑える。また輪郭振幅の小さい輪郭に対しては従来例どおりに輪郭補正を行うことができる。

【００４６】以上のように本発明の第２の実施例の輪郭補正装置によれば、どのような振幅の斜め方向の輪郭に対しても歪を生じることなく輪郭補正を行うことができる。

【００４７】なお、係数発生器の係数は０．５と１．０の２種類に限ったことではなく、その他の値を設定しても構わない。また、輪郭振幅の大きさに従って多段階に制御しても構わない。

【００４８】図７は、本発明の第３の実施例における輪郭補正装置の構成を示す図である。図４に示した第２の実施例と異なる点は、輪郭抽出回路１２０、ゲイン調整器１３０、加算器１４０、混合回路１５０が追加されている点である。図７a，b，c，d，e点の信号は輪郭抽出回路１２０に供給され、輪郭抽出回路１２０の出力信号はゲイン調整器１３０に供給される。ゲイン調整器１３０の出力信号は加算器１４０の一方の入力端子に供給されている。加算器１４０のもう一方の入力端子にはc点の信号が供給されており、加算結果は混合回路１５０の一方の入力端子に供給される。混合回路１５０のもう一方の入力端子には非線形処理回路９０の出力信号が供給され、混合回路１５０は輪郭振幅検出回路１１０の出力信号で制御される。混合回路１５０の出力信号は出力端子２に供給される。

【００４９】図７の第３の実施例における輪郭補正装置の動作について図８を用いて説明する。例えば、図１６に示す場合と同様に、振幅の異なる輪郭信号（図８（A）、（B））が入力された場合、注目点での波形は図８（c）であり、非線形処理回路９０の出力信号は図８（l）のように輪郭勾配補正型の処理を受けた輪郭補正信号が得られている。ここまでの動作は従来例で説明したものと同じである。

【００５０】図７a，b，c，d，e点における信号は輪郭抽出回路１２０に供給されている。輪郭抽出回路１２０は、たとえば図９に示す回路で構成される。図９において、１２１a，１２１b，１２１cは係数乗算器、１２２は多入力加算器である。係数乗算器１２１a，１２１b，１２１cの係数を、たとえば

ｋ１＝－１／４、ｋ２＝１／２、ｋ３＝－１／４

に設定し、乗算結果を多入力加算器１２２で加算すれば、加算結果として、図８（q）の波形をえる。つまり輪郭抽出回路１２０は、よく知られた高域通過型フィルタであり輪郭成分を抽出する。

【００５１】輪郭抽出回路１２０の出力信号はゲイン調整器１４０で振幅調整されたのち、加算器１４０において原信号（c）と加算され、加算出力として図８（r）に示すようなアンダーシュート、オーバーシュートを持つ高域周波数強調型の輪郭補正波形を得る。

【００５２】輪郭振幅検出回路１１０は基本的には図６と同じ構成であり、図６の減算器１１１の出力信号として図８（o）に示す信号がえられる。係数発生器１１２は入力信号振幅にしたがって混合回路１５０を制御する係数ｋｎを出力する。たとえば振幅があらかじめ設定した閾値１より小さい場合はｋｎ＝１．０、閾値１より大きく閾値２より小さい場合はｋｎ＝０．５、閾値２より大きい場合はｋｎ＝０とする。混合回路１５０は係数ｋｎにしたがってたとえば（数１）の演算を行う。

【００５３】

【数１】

$$\text{混合出力} = kn \times \ell + (1 - kn) \times r$$
$$0 \leqq kn \leqq 1$$

【００５４】（数１）によればｋｎが小さいほど、つまり輪郭振幅が大きいほど図８（r）に示す高域周波数強調型の輪郭補正信号の混合比率を大きくして出力する。したがって混合回路１５０の出力信号として図８（s）

に示す信号を得る。

【0055】この波形をから明かなように輪郭振幅が大きくコントラストのある輪郭については高域周波数強調型の輪郭補正信号の比率を大きくすることで、特に斜め方向の輪郭において歪の発生を抑え、かつ輪郭補正効果も出すことができる。高域周波数強調型の輪郭補正はすべて線形処理であるから、斜め方向の輪郭を処理しても歪は発生しない。また輪郭振幅の小さい輪郭に対しては輪郭勾配補正型の輪郭補正を行う。

【0056】以上のように本発明の第3の実施例の輪郭補正装置によれば、どのような振幅の斜め方向の輪郭に対しても歪を生じることなく輪郭補正を行うことができる。

【0057】なお、混合回路の混合比率は3段階に限ったことではなく、輪郭振幅の大きさに従って多段階に設定しても構わない。また、輪郭抽出回路の構成はこれに限ったことではなく、高域通過型の周波数特性を実現するものならどのような構成のものであっても構わない。

【0058】図10は本発明の第4の実施例における輪郭補正装置の構成を示す図である。図10において200はサンプリングレート変換器、400は輪郭補正部である。輪郭補正部は、たとえば図13に示した従来の輪郭補正装置と基本的には同じ構成であり、従来例と異なる点は従来例の1画素遅延器が4画素遅延器300a，300b，300c，300dに置き変わっている点である。

【0059】以下図10の輪郭補正装置について、図11を用いながらその動作を説明する。まず、入力映像信号は図11（a）に示すように、1画素あたりサンプリング周期Ts（sec）でサンプリングされたサンプリング値列であるとし、このサンプル値列はサンプリングレート変換器200に供給される。サンプリングレート変換器200は、たとえば図12に示す回路で構成されている。図12において201は零挿入回路、202は補間回路である。

【0060】まず、図11（a）のサンプリング値列は零挿入回路201に供給される。たとえば、原サンプリング周期Ts（sec）を1／4に変換する場合、零挿入回路201ではサンプリング周期Tsでサンプリングされた各サンプリング値間にTs／4間隔で3個の零点を挿入する。零点を挿入することで図11（b）に示すように挿入された零点をふくめてそれぞれの画素間のサンプリング周期はTs／4に変換される。図11（b）に示すように、零挿入されてサンプリング周期がTs／4に変換されたサンプリング値列は補間回路202に供給される。補間回路120は、たとえば荷重加算器であり、挿入された零点はその周辺の原サンプリング値を用いて荷重加算により補間され、図11（c）に示すようなサンプリング周期Ts／4のサンプリング値列が得られる。サンプリング周期Ts／4のサンプリング値列は輪郭補正部400に供給される。輪郭補正部400は従来例で説明した輪郭補正回路と同様に処理され、輪郭補正部400の出力信号として図11（d）に示す輪郭補正波形（サンプリング値列）が得られる。

【0061】この図から明かなように1画素の間隔（最小のシフト幅）が従来例の輪郭補正装置に比べて1／4になるため斜めの輪郭に対して輪郭補正した場合に生じる歪を抑えることができる。

【0062】以上のように本発明の第4の実施例における輪郭補正装置によれば斜め方向の輪郭に対しても歪を生じることなく輪郭補正を行うことができる。

【0063】なお、サンプリングレート変換器はこの構成に限ったことではなく、変換後のサンプリング周期が変換前サンプリング周期より小さくなるものであればどのような構成のものを用いても構わない。また4画素遅延器はこの値に限ったものではなく変換後のサンプリング周期にあわせて任意に設定すればよい。

【0064】

【発明の効果】以上のように本発明は、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出回路と前記最小値検出回路と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する加算手段と、前記加算手段の出力信号を入力とする非線形処理手段と、前記注目画素近傍の複数の画素信号と前記最大値検出手段からの出力信号と前記最小値検出手段からの出力信号を入力とし、最大値と最小値の発生位置を検出する位置検出手段とを設けることにより、原画像本来の幾何学的構造を失うことなく高品質な輪郭補正画像を得ることができる。

【0065】また、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出手段と前記最小値検出手段と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する加算手段と、前記加算手段の出力信号を入力とする非線形処理手段と、前記最大値検出手段からの出力信号と前記最小値検出手段から出力信号を入力とし輪郭の振幅を検出する輪郭振幅検出手段とを設けることにより、斜め方向の輪郭で生じる歪を抑圧した高品質な輪郭補正画像を得ることができる。

【0066】さらに、入力映像信号の注目画素近傍の複数の画素信号から最大値を検出する最大値検出手段と、入力映像信号の注目画素近傍の複数の画素信号から最小値を検出する最小値検出手段と、前記最大値検出手段と

前記最小値検出手段と前記入力映像信号を入力とし演算処理する演算手段と、前記演算手段の出力信号を入力とする振幅調整手段と、前記振幅調整手段の出力信号と前記入力映像信号を加算する第一の加算手段と、前記第一の加算手段の出力信号を入力とする非線形処理手段と、前記最大値検出手段からの出力信号と前記最小値検出手段から出力信号を入力とし輪郭の振幅を検出する輪郭振幅検出手段と、入力映像信号の注目画素近傍の複数の画素信号を入力とし輪郭補正成分を抽出する輪郭抽出手段と、前記輪郭抽出手段からの出力信号と前記入力映像信号を加算する第二の加算手段と、前記第二の加算手段からの出力信号と前記非線形処理手段の出力信号を混合する混合手段とを備えることにより、斜め方向の輪郭で生じる歪を抑圧するとともに、アンダーシュートおよびオーバーシュートを付加した高品質な輪郭補正画像を得ることができる。

【００６７】さらに、標本化周期ｔ１の離散化映像信号を標本化周期ｔ２に変換する標本化周期変換手段と、標本化周期ｔ２に変換された離散化映像信号を入力とする輪郭補正手段とを備えることにより、斜め方向の輪郭で生じる歪を抑圧することができる。

【図面の簡単な説明】

【図１】本発明の第１の実施例における輪郭補正装置の構成図

【図２】本発明の第１の実施例における輪郭補正装置の動作を説明するため波形図

【図３】位置検出回路の構成図

【図４】本発明の第２の実施例における輪郭補正装置の構成図

【図５】（Ａ）は第２の実施例における輪郭補正装置の動作を説明するため波形図

（Ｂ）は同輪郭補正装置の動作を説明するため波形図

【図６】輪郭振幅検出回路の構成図

【図７】本発明の第３の実施例における輪郭補正装置の構成図

【図８】（Ａ）は第３の実施例における輪郭補正装置の動作を説明するため波形図

（Ｂ）は同輪郭補正装置の動作を説明するため波形図

【図９】輪郭抽出回路の構成図

【図１０】本発明の第４の実施例における輪郭補正装置の構成図

【図１１】本発明の第４の実施例における輪郭補正装置の動作を説明するため波形図

【図１２】サンプリングレート変換器の構成図

【図１３】従来例における輪郭補正装置の構成図

【図１４】従来例における輪郭補正装置の動作を説明するための波形図

【図１５】従来例における輪郭補正装置の課題を説明するための波形図

【図１６】（Ａ）は従来例における輪郭補正装置の課題を説明するための波形図

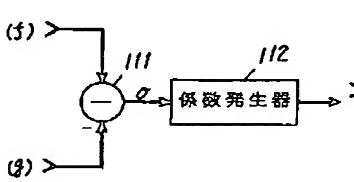
（Ｂ）は同輪郭補正装置の課題を説明するための波形図

【図１７】従来例における輪郭補正装置の課題を説明するための波形図

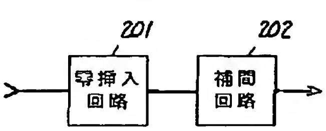
【符号の説明】

１　入力端子
２　出力端子
１０　平均値回路
２０　減算器
３０　１画素遅延器
４０　最大値検出回路
５０　最小値検出回路
７０　ゲイン調整器
８０　加算器
９０　非線形処理回路
１００　位置検出回路
１１０　輪郭振幅検出回路
１２０　輪郭抽出回路
１３０　ゲイン調整器
１４０　加算器
１５０　混合回路
２００　サンプリングレート変換器
３００　演算回路
４００　輪郭補正部

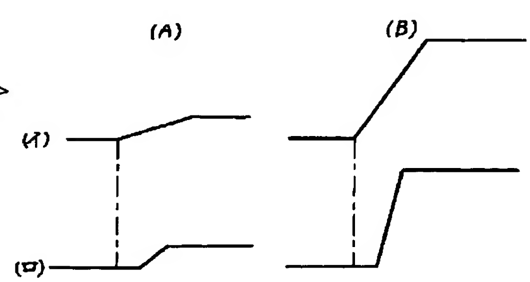
【図６】



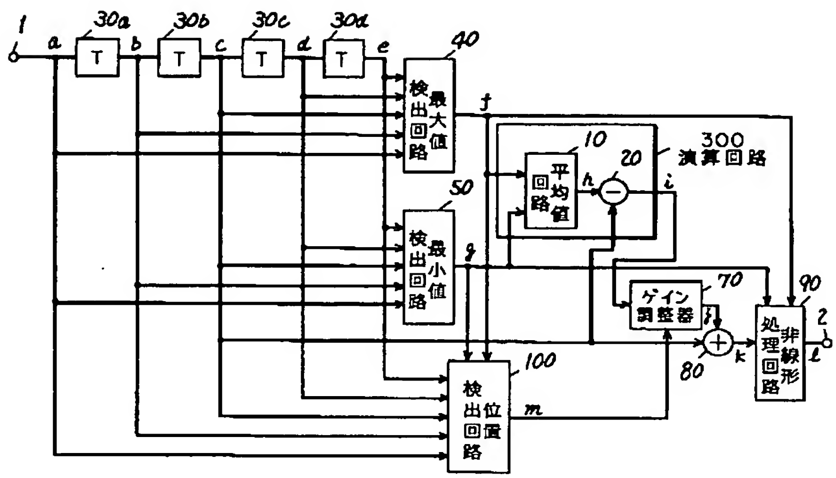
【図１２】



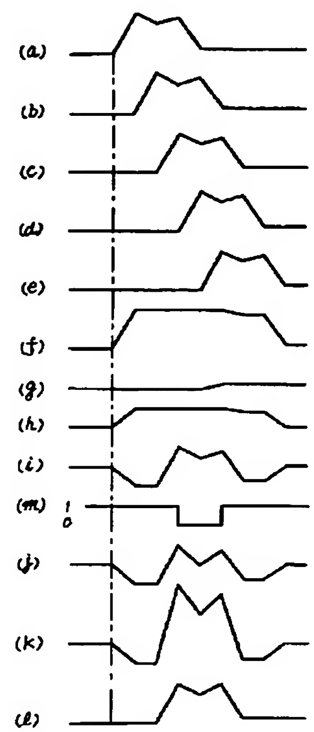
【図１６】



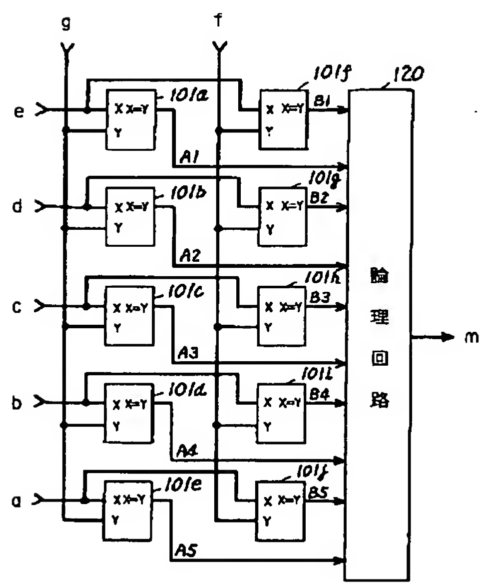
【図1】



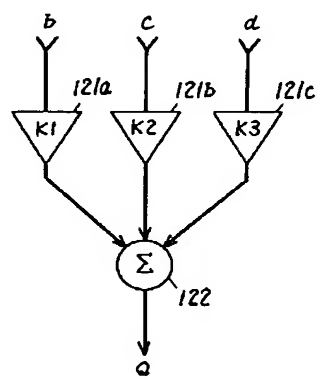
【図2】



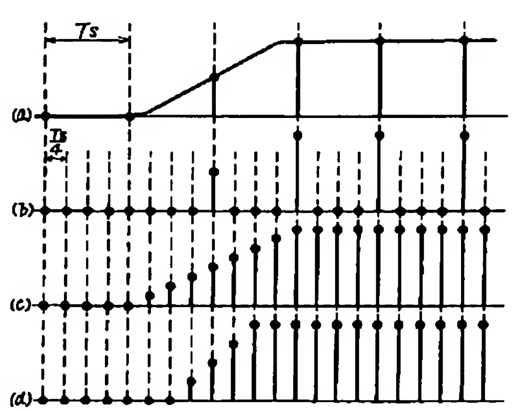
【図3】



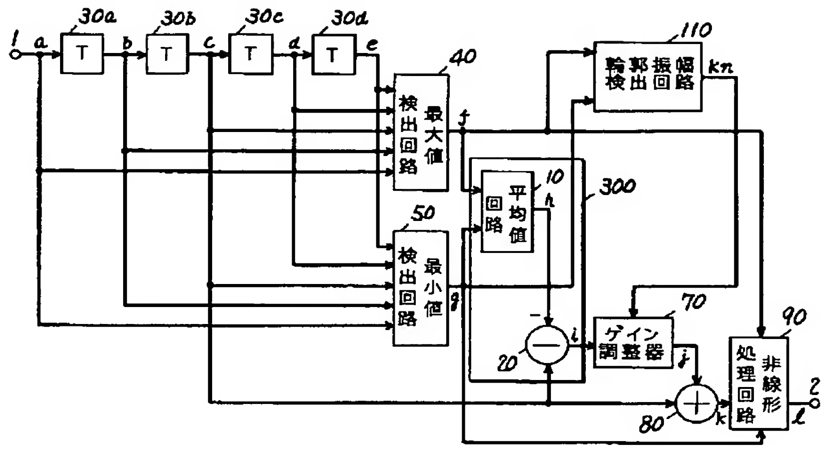
【図9】



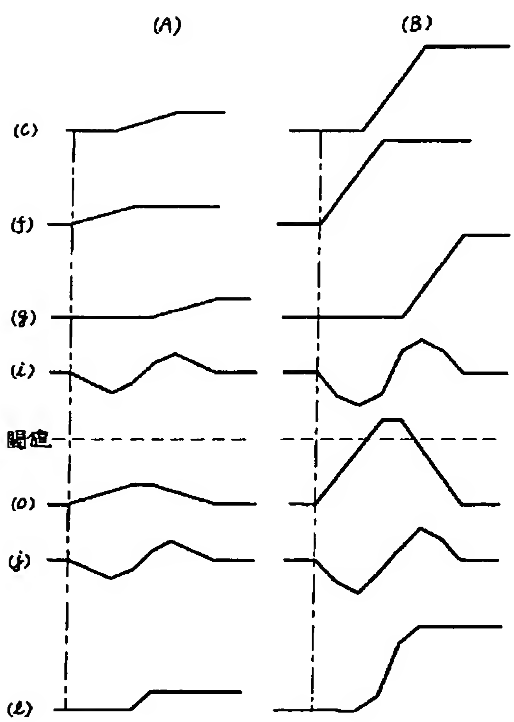
【図11】



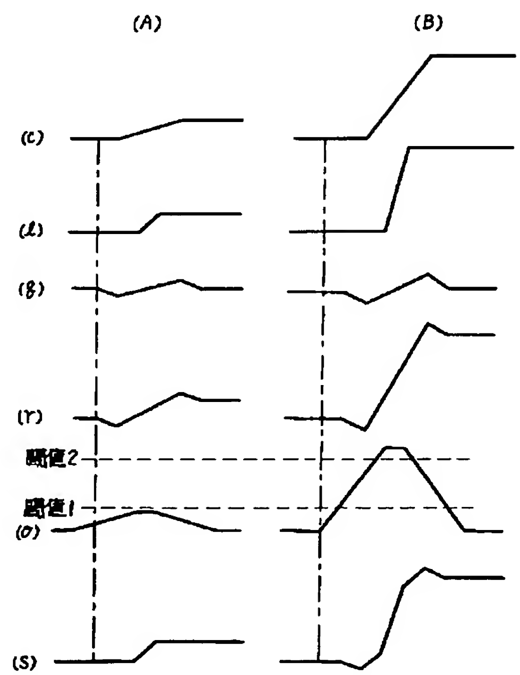
【図４】


1
a
b
c
d
e
30a
30b
30c
30d
T
T
T
T
40
最大値検出回路
50
最小値検出回路
f
g
10
平均値回路
h
300
110
輪郭振幅検出回路
kn
20
i
70
ゲイン調整器
j
80
k
90
非線形処理回路
2
ℓ

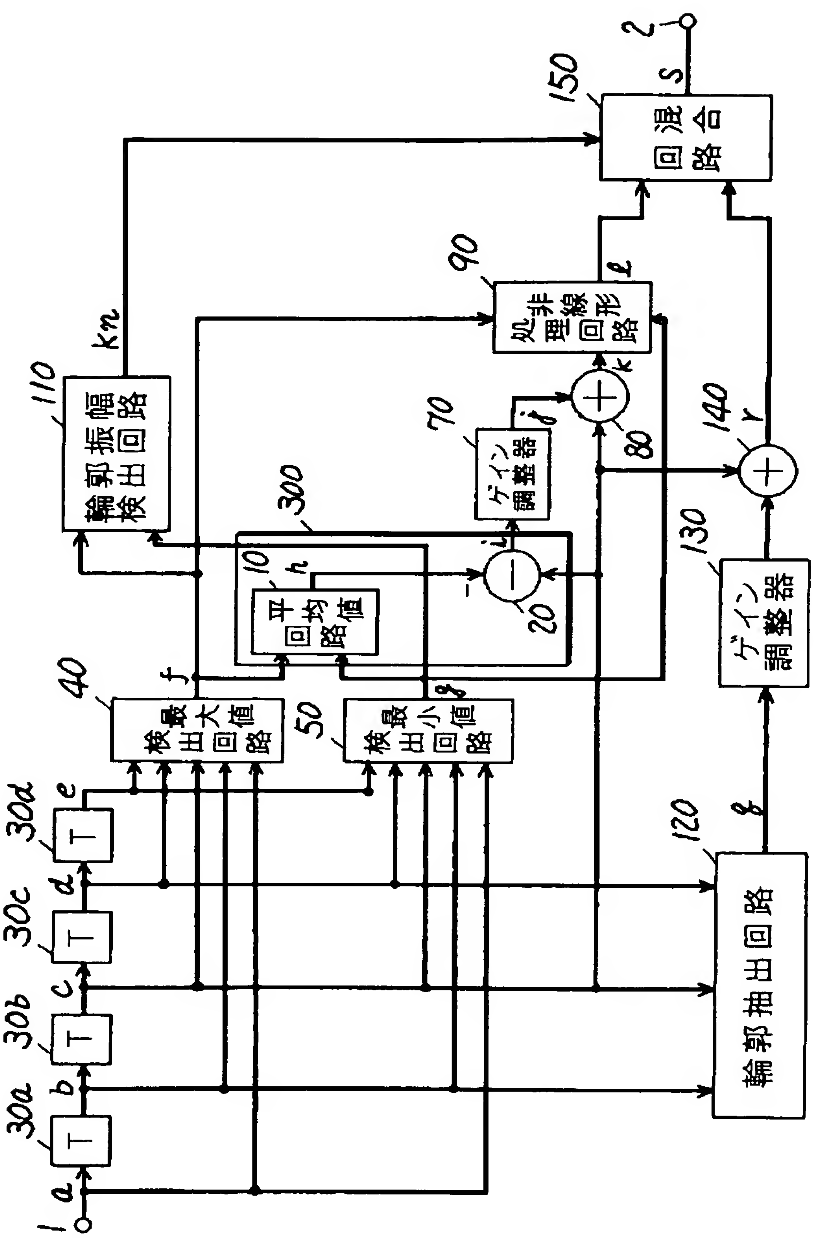
【図５】


(A)
(B)
(c)
(f)
(g)
(i)
閾値
(o)
(j)
(ℓ)

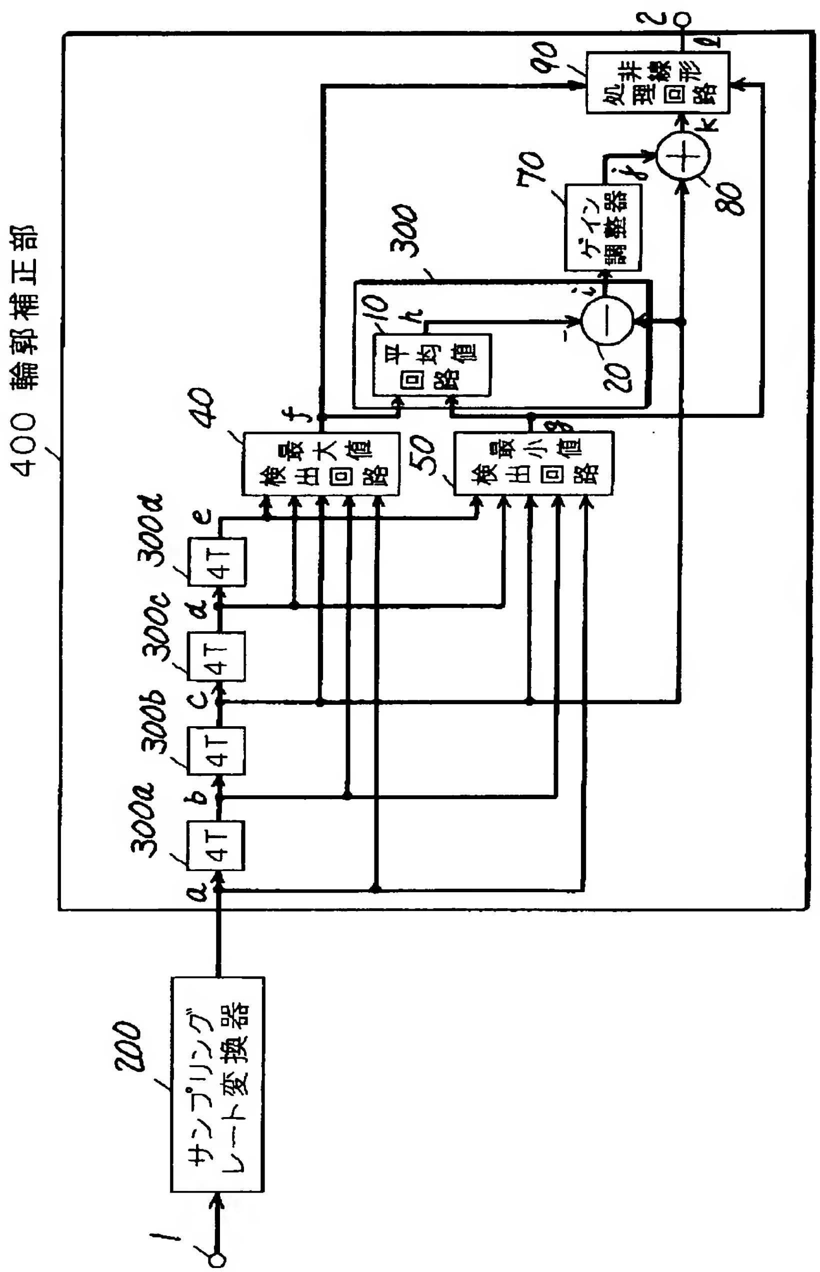
【図８】


(A)
(B)
(c)
(ℓ)
(g)
(r)
閾値2
閾値1
(o)
(s)

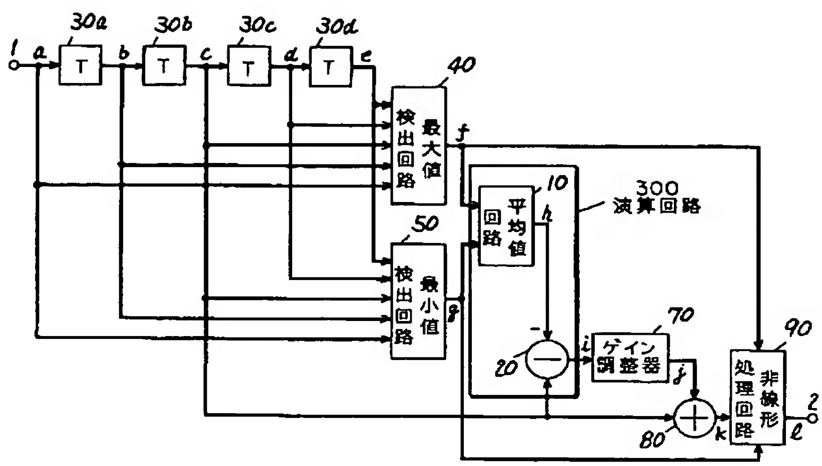
【図７】


1
2
a
b
c
d
e
f
g
h
i
j
k
ℓ
r
s
kn
30a
30b
30c
30d
T
10
平均値回路
20
40
最大値検出回路
50
最小値検出回路
70
ゲイン調整器
80
90
非線形処理回路
110
輪郭振幅検出回路
120
輪郭抽出回路
130
ゲイン調整器
140
150
混合回路
300

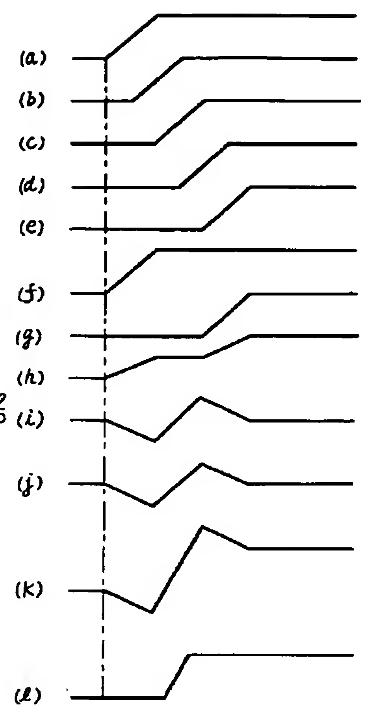
【図１０】


400 輪郭補正部
200 サンプリングレート変換器
300a 4T
300b 4T
300c 4T
300d 4T
40 最大値検出回路
50 最小値検出回路
10 平均値回路
20
300
70 ゲイン調整器
80
90 非線形処理回路
1
2

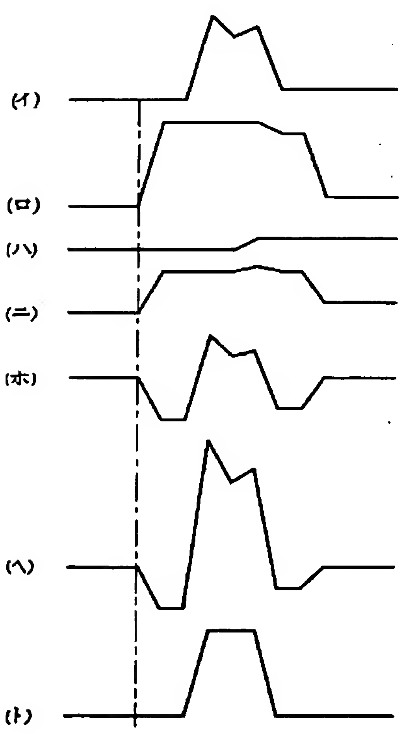
【図１３】



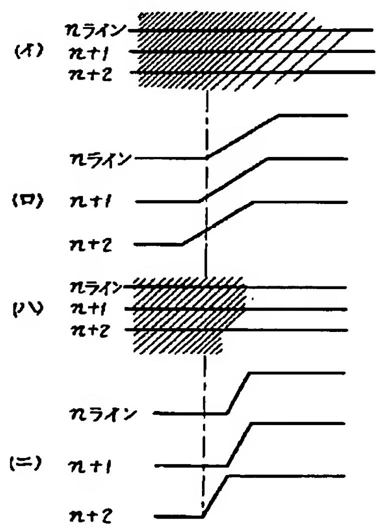
【図１４】



【図１５】



【図１７】



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